

12

Marginal Costing

Learning Objectives

When you have finished studying this chapter, you should be able to

- Understand the difference between absorption costing and marginal costing
- Understand the concept of contribution and contribution to sales ratio.
- Understand the method of computation of break-even point, both mathematically and also with the help of a graph.
- Understand the basic limitations of break even analysis

12.1 Definitions

In order to appreciate the concept of marginal costing, it is necessary to study the definition of marginal costing and certain other terms associated with this technique. The important terms have been defined as follows:

1. **Marginal Costing:** The ascertainment of marginal cost and of the effect on profit of changes in volume or type of output by differentiating between fixed costs and variable costs.
2. **Marginal Cost:** The amount at any given volume of output by which aggregate variable costs are changed if the volume of output is increased by one unit. In practice this is measured by the total variable cost attributable to one unit. Marginal cost can precisely be the sum of prime cost and variable overhead.

Marginal Cost = Variable Cost = Direct Labour + Direct Material + Direct Expenses + Variable Overheads

Note: In this context a unit may be a single article, a batch of articles, an order, a stage of production capacity, a process or a department. It relates to the change in output in particular circumstances under consideration.

3. **Direct Costing:** Direct costing is the practice of charging all direct cost to operations, processes or products, leaving all indirect costs to be written off against profits in the period in which they arise. Under direct costing the stocks are valued at direct costs, i.e., costs whether fixed or variable which can be directly attributable to the cost units.
4. **Differential Cost:** It may be defined as “the increase or decrease in total cost or the

change in specific elements of cost that result from any variation in operations". It represents an increase or decrease in total cost resulting out of:

- (a) producing or distributing a few more or few less of the products;
- (b) a change in the method of production or of distribution;
- (c) an addition or deletion of a product or a territory; and
- (d) selection of an additional sales channel.

Differential cost, thus includes fixed and semi-variable expenses. It is the difference between the total costs of two alternatives. It is an *ad-hoc* cost determined for the purpose of choosing between competing alternatives, each with its own combination of income and costs.

5. Incremental Cost: It is defined as, "the additional costs of a change in the level or nature of activity". As such for all practical purposes there is no difference between incremental cost and differential cost. However, from a conceptual point of view, differential cost refers to both incremental as well as decremental cost. Incremental cost and differential cost calculated from the same data will be the same. In practice, therefore, generally no distinction is made between differential cost and incremental cost. One aspect which is worthy to note is that incremental cost is not the same at all levels. Incremental cost between 50% and 60% level of output may be different from that which is arrived at between 80% and 90% level of output. Differential cost or incremental cost analysis deals with both short-term and long-term problems. This analysis is more useful when various alternatives or various capacity levels are being considered. (will be discussed in the next chapter i.e. Budgets and Budgetary Control)

6. Contribution: Contribution or the contributory margin is the difference between sales value and the marginal cost [Contribution (C) = Sales (S) – Variable Cost]. It is obtained by subtracting marginal cost from sales revenue of a given activity. It can also be defined as excess of sales revenue over the variable cost. The contribution concept is based on the theory that the profit and fixed expenses of a business is a 'joint cost' which cannot be equitably apportioned to different segments of the business. In view of this difficulty the contribution serves as a measure of efficiency of operations of various segments of the business. The contribution forms a fund for fixed expenses and profit as illustrated below:

Example:

Variable Cost	= ₹ 50, 000, Fixed Cost = ₹ 20,000, Selling Price = ₹ 80,000
Contribution	= Selling Price – Variable Cost
	= ₹ 80,000 – ₹ 50,000 = ₹ 30,000
Profit	= Contribution – Fixed Cost
	= ₹ 30,000 – ₹ 20,000 = ₹ 10,000

Since, contribution exceeds fixed cost; the profit is of the magnitude of ₹ 10,000. Suppose the fixed cost is ₹ 40,000 then the position shall be:

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$$\text{Contribution} - \text{Fixed cost} = \text{Profit or,} \quad = ₹ 30,000 - ₹ 40,000 = - ₹ 10,000$$

The amount of ₹ 10,000 represent extent of loss since the fixed costs are more than the contribution. At the level of fixed cost of ₹ 30,000, there shall be no profit and no loss.

7. Key Factor: Key factor or Limiting factor is a factor which at a particular time or over a period limits the activities of an undertaking. It may be the level of demand for the products or services or it may be the shortage of one or more of the productive resources, e.g., labour hours, available plant capacity, raw material's availability etc. Examples of Key Factors or Limiting Factors are:

- (a) Shortage of raw material.
- (b) Shortage of labour.
- (c) Plant capacity available.
- (d) Sales capacity available.
- (e) Cash availability.

12.2 Characteristics of Marginal Costing

The technique of marginal costing is based on the distinction between product costs and period costs. Only the variables costs are regarded as the costs of the products while the fixed costs are treated as period costs which will be incurred during the period regardless of the volume of output. The main characteristics of marginal costing are as follows:

1. All elements of cost are classified into fixed and variable components. Semi-variable costs are also analyzed into fixed and variable elements.
2. The marginal or variable costs (as direct material, direct labour and variable factory overheads) are treated as the cost of product.
3. Under marginal costing, the value of finished goods and work-in-progress is also comprised only of marginal costs. Variable selling and distribution are excluded for valuing these inventories. Fixed costs are not considered for valuation of closing stock of finished goods and closing WIP.
4. Fixed costs are treated as period costs and are charged to profit and loss account for the period for which they are incurred.
5. Prices are determined with reference to marginal costs and contribution margin.
6. Profitability of departments and products is determined with reference to their contribution margin.

12.3 Facts about Marginal Costing

Some of the facts about marginal costing are depicted below

Not a distinct method: Marginal costing is not a distinct method of costing like job costing, process costing, operating costing, etc., but a special technique used for managerial decision

making. Marginal costing is used to provide a basis for the interpretation of cost data to measure the profitability of different products, processes and cost centres in the course of decision making. It can, therefore, be used in conjunction with the different methods of costing such as job costing, process costing, etc., or even with other techniques such as standard costing or budgetary control.

Cost Ascertainment: In marginal costing, cost ascertainment is made on the basis of the nature of cost. It gives consideration to behaviour of costs. In other words, the technique has developed from a particular conception and expression of the nature and behaviour of costs and their effect upon the profitability of an undertaking.

Decision Making: In the orthodox or total cost method, as opposed to marginal costing method, the classification of costs is based on functional basis. Under this method the total cost is the sum total of the cost of direct material, direct labour, direct expenses, manufacturing overheads, administration overheads, selling and distribution overheads. In this system, other things being equal, the total cost per unit will remain constant only when the level of output or mixture is the same from period to period. Since these factors are continually fluctuating, the actual total cost will vary from one period to another. Thus, it is possible for the costing department to say one day that an item costs ₹20 and the next day it costs ₹18. This situation arises because of changes in volume of output and the peculiar behaviour of fixed expenses included in the total cost. Such fluctuating manufacturing activity, and consequently the variations in the total cost from period to period or even from day to day, poses a serious problem to the management in taking sound decisions. Hence, the application of marginal costing has been given wide recognition in the field of decision making.

12.4 Distinction between Marginal and Absorption Costing

The distinctions in these two techniques are illustrated by the following diagrams:

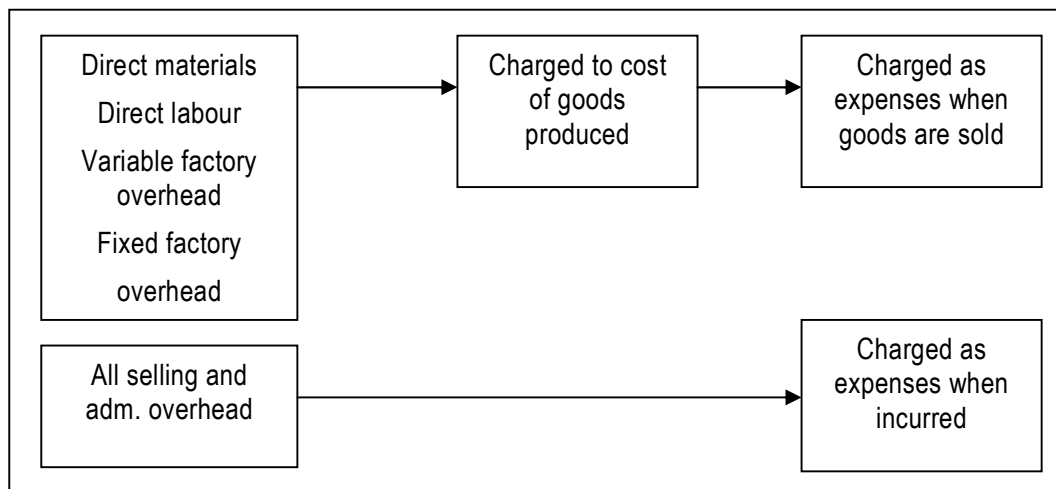


Fig. 12.1 Absorption Costing Approach

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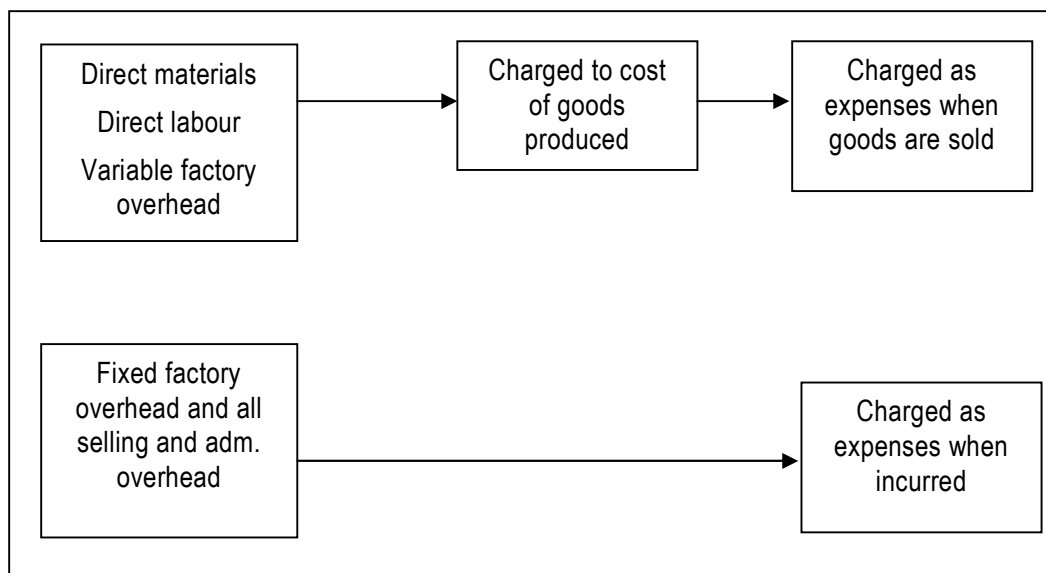


Fig. .2 Marginal Costing Approach

12.4.1 The main points of distinction between marginal costing and absorption costing are as below:

	Marginal costing	Absorption costing
1.	Only variable costs are considered for product costing and inventory valuation.	Both fixed and variable costs are considered for product costing and inventory valuation.
2.	Fixed costs are regarded as period costs. The Profitability of different products is judged by their P/V ratio.	Fixed costs are charged to the cost of production. Each product bears a reasonable share of fixed cost and thus the profitability of a product is influenced by the apportionment of fixed costs.
3.	Cost data presented highlight the total contribution of each product.	Cost data are presented in conventional pattern. Net profit of each product is determined after subtracting fixed cost along with their variable costs.
4.	The difference in the magnitude of opening stock and closing stock does not affect the unit cost of production.	The difference in the magnitude of opening stock and closing stock affects the unit cost of production due to the impact of related fixed cost.
5.	In case of marginal costing the cost per unit remains the same, irrespective of the production as it is valued at variable cost	In case of absorption costing the cost per unit reduces, as the production increases as it is fixed cost which reduces, whereas, the variable cost remains the same per unit.

12.4.2 Difference in profit under Marginal and Absorption costing: The above two approaches will compute the different profit because of the difference in the stock valuation. This difference is explained as follows in different circumstances.

1. No opening and closing stock: In this case, profit / loss under absorption and marginal costing will be equal.
2. When opening stock is equal to closing stock: In this case, profit / loss under two approaches will be equal provided the fixed cost element in both the stocks is same amount.
3. When closing stock is more than opening stock: In other words, when production during a period is more than sales, then profit as per absorption approach will be more than that by marginal approach. The reason behind this difference is that a part of fixed overhead included in closing stock value is carried forward to next accounting period.
4. When opening stock is more than the closing stock: In other words when production is less than the sales, profit shown by marginal costing will be more than that shown by absorption costing. This is because a part of fixed cost from the preceding period is added to the current year's cost of goods sold in the form of opening stock.

12.4.3 Comparison between Direct Costing and Marginal Costing: In general, the terms marginal costing and direct costing are used as synonymous. However, direct costing differs from marginal costing in that some fixed costs considered direct are charged to operations, processes or products, whereas in marginal costing only variable costs are considered. Marginal costing is mainly concerned with providing of information to management to assist in decision making and for exercising control. Marginal costing is considered to be a technique with a broader meaning than direct costing. Marginal costing is also known as 'variable costing' or 'out of pocket costing'.

12.4.4 Absorption Costing:

- In absorption costing the classification of expenses is based on functional basis whereas in marginal costing it is based on the nature of expenses.
- In absorption costing, the fixed expenses are distributed over products on absorption costing basis that is, based on a pre-determined level of output. Since fixed expenses are constant, such a method of recovery will lead to over or under-recovery of expenses depending on the actual output being greater or lesser than the estimate used for recovery. This difficulty will not arise in marginal costing because the contribution is used as a fund for meeting fixed expenses.

The presentation of information to management under the two costing techniques is as under:

12.7 Cost Accounting

Income Statement (Absorption costing)

		(₹)
Sales		<u>XXXXX</u>
Production Costs:		
Direct material consumed		XXXXX
Direct labour cost		XXXXX
Variable manufacturing overhead		XXXXX
Fixed manufacturing overhead		<u>XXXXX</u>
Cost of Production		XXXXX
Add: Opening stock of finished goods		<u>XXXXX</u>
(Value at cost of previous period's production)		
		XXXXX
Less: Closing stock of finished goods		XXXXX
(Value at production cost of current period)		
Cost of Goods Sold		<u> </u>
Add: (or less) Under (or over) absorption of fixed		
Manufacturing overhead		XXXXX
Add: Selling and distribution costs	XXXXX	
Administration costs	<u>XXXXX</u>	<u>XXXXX</u>
Total Cost		XXXXX
Profit (Sales – Total cost)		XXXXX

Income Statement (Marginal costing)

		(₹)
Sales		<u>XXXXX</u>
Variable manufacturing costs:		
– Direct material consumed		XXXXX
– Direct labour		XXXXX
– Variable manufacturing overhead		<u>XXXXX</u>
Cost of Goods Produced		XXXXX
Add: Opening stock of finished goods		XXXXX

	(Value at cost of previous period)	
Less:	Closing stock of finished goods (Value at current variable cost)	
	Cost of Goods Sold	XXXXX
Add:	Variable administration, selling and dist. overhead	XXXXX
	Total Variable Cost	XXXXX
Add:	Selling and distribution costs	
	Contribution (Sales – Total variable costs)	XXXXX
Less:	Fixed costs (Production, adm., selling and dist.)	XXXXX
	Net Profit	XXXXX

It is evident from the above that under marginal costing technique the contributions of various products are pooled together and the fixed overheads are met out of such total contribution. The total contribution is also known as gross margin. The contribution minus fixed expenses yields net profit. In absorption costing technique cost includes fixed overheads as well.

Illustration 1 (Calculation of profit under marginal costing and absorption costing)

WONDER LTD. manufactures a single product, ZEST. The following figures relate to ZEST for a one-year period:

Activity Level	50%	100%
Sales and production (units)	400	800
	₹ lakhs	₹ lakhs
Sales	8.00	16.00
Production costs:		
Variable	3.20	6.40
Fixed	1.60	1.60
Selling and administration costs:		
Variable	1.60	3.20
Fixed	2.40	2.40

The normal level of activity for the year is 800 units. Fixed costs are incurred evenly throughout the year, and actual fixed costs are the same as budgeted. There were no stocks of ZEST at the beginning of the year.

In the first quarter, 220 units were produced and 160 units were sold.

Required:

- What would be the fixed production costs absorbed by ZEST if absorption costing is used?
- What would be the under/over-recovery of overheads during the period?

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(c) What would be the profit using absorption costing?

(d) What would be the profit using marginal costing?

Solution

(a) Fixed production costs absorbed:		(₹)
Budgeted fixed production costs		1,60,000
Budgeted output (normal level of activity 800 units)		
Therefore, the absorption rate : $1,60,000/800 = ₹ 200$ per unit		
During the first quarter, the fixed production cost absorbed by ZEST would be (220 units × ₹ 200)		44,000
(b) Under /over-recovery of overheads during the period:		(₹)
Actual fixed production overhead		40,000
(1/4 of ₹ 1,60,000)		
Absorbed fixed production overhead		44,000
Over-recovery of overheads		4,000
(c) Profit for the Quarter (Absorption Costing)		(₹) (₹)
Sales revenue (160 units × ₹ 2,000) : (A)		3,20,000
Less: Production costs		
Variable (220 units × ₹ 800)	1,76,000	
Fixed overheads absorbed (220 units × ₹ 200)	<u>44,000</u>	
Total (220 units × ₹ 1,000)	2,20,000	
Less: Closing stock (60 units × ₹ 1,000)	<u>60,000</u>	
Production cost of 160 units	1,60,000	
Variable sales & admn. costs (160 units × ₹ 400)	64,000	
Fixed selling & admn. costs (1/4 of ₹ 2,40,000)	60,000	
Total cost of sales of 160 units : (B)		<u>2,84,000</u>
Unadjusted profit : {(A) – (B)}		36,000
Add: Overheads over absorbed		4,000
Actual profit		<u>40,000</u>
(d) Profit for the Quarter (Marginal Costing)		(₹) (₹)
Sales revenue (160 units × ₹ 2,000) : (A)		3,20,000
Variable production costs (220 units × ₹ 800)	1,76,000	
Less: Closing stock (60 units × ₹ 800)	<u>48,000</u>	
Variable production cost of 160 units	1,28,000	
Add: Variable selling & admn. costs	<u>64,000</u>	
Total variable cost of sales of 160 units : (B)		<u>1,92,000</u>
Contribution : {(A) – (B)}		1,28,000

Less: Fixed production cost incurred	40,000	
Fixed selling & admn. costs incurred	<u>60,000</u>	<u>1,00,000</u>
Actual profit		<u>28,000</u>

Illustration 2 (Reasons for difference in profit under marginal and absorption costing)

XYZ Ltd. has a production capacity of 2,00,000 units per year. Normal capacity utilisation is reckoned as 90%. Standard variable production costs are ₹11 per unit. The fixed costs are ₹3,60,000 per year. Variable selling costs are ₹3 per unit and fixed selling costs are ₹2,70,000 per year. The unit selling price is ₹20.

In the year just ended on 30th June, 2014, the production was 1,60,000 units and sales were 1,50,000 units. The closing inventory on 30th June was 20,000 units. The actual variable production costs for the year were ₹35,000 higher than the standard.

- (i) Calculate the profit for the year
 - (a) by absorption costing method and
 - (b) by marginal costing method.
- (ii) Explain the difference in the profits.

Solution:

**Income Statement (Absorption Costing)
for the year ending 30th June 2014**

	(₹)	(₹)
Sales (1,50,000 units @ ₹20)		<u>30,00,000</u>
Production Costs :		
Variable (1,60,000 units @ ₹11)	17,60,000	
Add :Increase	<u>35,000</u>	17,95,000
Fixed (1,60,000 units @ ₹2*)		<u>3,20,000</u>
Cost of Goods Produced		21,15,000
Add :Opening stock (10,000 units @ ₹13)*		<u>1,30,000</u>
		22,45,000
Less :Closing stock $\left(\frac{₹ 21,15,000}{1,60,000 \text{ units}} \times 20,000 \text{ units} \right)$		<u>2,64,375</u>
Cost of Goods Sold		19,80,625
Add :Under absorbed fixed production overhead (3,60,000 – 3,20,000)		<u>40,000</u>
		20,20,625
Add :Non-production costs :		
Variable selling costs (1,50,000 units @ ₹3)		4,50,000

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Fixed selling costs	<u>2,70,000</u>
Total cost	<u>27,40,625</u>
Profit (Sales – Total Cost)	<u>2,59,375</u>

* Working Notes :

- Fixed production overhead are absorbed at a pre-determined rate based on normal capacity, i.e. ₹3,60,000 ÷ 1,80,000 units = ₹ 2.
- Opening stock is 10,000 units, i.e., 1,50,000 units + 20,000 units – 1,60,000 units. It is valued at ₹13 per unit, i.e., ₹11 + ₹2 (Variable + fixed).

Income Statement (Marginal Costing)

for the year ended 30th June, 2014

	(₹)	(₹)
Sales (1,50,000 units @ ₹20)		<u>30,00,000</u>
Variable production cost (1,60,000 units @ ₹11 + ₹35,000)		<u>17,95,000</u>
Variable selling cost (1,50,000 units @ ₹3)		<u>4,50,000</u>
		22,45,000
Add : Opening Stock (10,000 units @ ₹11)		<u>1,10,000</u>
		23,55,000
Less : Closing stock $\left(\frac{₹17,95,000}{1,60,000} \times 20,000 \text{ units} \right)$		<u>2,24,375</u>
Variable cost of goods sold		<u>21,30,625</u>
Contribution (Sales – Variable cost of goods sold)		<u>8,69,375</u>
Less : Fixed cost – Production	3,60,000	
– Selling	<u>2,70,000</u>	<u>6,30,000</u>
Profit		<u>2,39,375</u>

Reasons for Difference in Profit:	(₹)
Profit as per absorption costing	2,59,375
Add : Op. stock under –valued in marginal costing (₹1,30,000 – 1,10,000)	<u>20,000</u>
	2,79,375
Less : Cl. Stock under –valued in marginal closing (₹2,64,375 – 2,24,375)	<u>40,000</u>
Profit as per marginal costing	<u>2,39,375</u>

12.5 Advantages and Limitations of Marginal Costing

Advantages

1. **Simplified Pricing Policy:** The marginal cost remains constant per unit of output whereas the fixed cost remains constant in total. Since marginal cost per unit is constant from period to period within a short span of time, firm decisions on pricing policy can be taken. If fixed cost is included, the unit cost will change from day to day depending upon the volume of output. This will make decision making task difficult.
2. **Proper recovery of Overheads:** Overheads are recovered in costing on the basis of pre-determined rates. If fixed overheads are included on the basis of pre-determined rates, there will be under-recovery of overheads if production is less or if overheads are more. There will be over-recovery of overheads if production is more than the budget or actual expenses are less than the estimate. This creates the problem of treatment of such under or over-recovery of overheads. Marginal costing avoids such under or over recovery of overheads.
3. **Shows Realistic Profit:** Advocates of marginal costing argues that under the marginal costing technique, the stock of finished goods and work-in-progress are carried on marginal cost basis and the fixed expenses are written off to profit and loss account as period cost. This shows the true profit of the period.
4. **How much to produce:** Marginal costing helps in the preparation of break-even analysis which shows the effect of increasing or decreasing production activity on the profitability of the company.
5. **More control over expenditure:** Segregation of expenses as fixed and variable helps the management to exercise control over expenditure. The management can compare the actual variable expenses with the budgeted variable expenses and take corrective action through analysis of variances.
6. **Helps in Decision Making:** Marginal costing helps the management in taking a number of business decisions like make or buy, discontinuance of a particular product, replacement of machines, etc.
7. **Short term profit planning:** It helps in short term profit planning by B.E.P charts.

Limitations

1. **Difficulty in classifying fixed and variable elements:** It is difficult to classify exactly the expenses into fixed and variable category. Most of the expenses are neither totally variable nor wholly fixed. For example, various amenities provided to workers may have no relation either to volume of production or time factor.
2. **Dependence on key factors:** Contribution of a product itself is not a guide for optimum profitability unless it is linked with the key factor.

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3. **Scope for Low Profitability:** Sales staff may mistake marginal cost for total cost and sell at a price; which will result in loss or low profits. Hence, sales staff should be cautioned while giving marginal cost.
4. **Faulty valuation:** Overheads of fixed nature cannot altogether be excluded particularly in large contracts, while valuing the work-in-progress. In order to show the correct position fixed overheads have to be included in work-in-progress.
5. **Unpredictable nature of Cost:** Some of the assumptions regarding the behaviour of various costs are not necessarily true in a realistic situation. For example, the assumption that fixed cost will remain static throughout is not correct. Fixed cost may change from one period to another. For example salaries bill may go up because of annual increments or due to change in pay rate etc. The variable costs do not remain constant per unit of output. There may be changes in the prices of raw materials, wage rates etc. after a certain level of output has been reached due to shortage of material, shortage of skilled labour, concessions of bulk purchases etc.
6. **Marginal costing ignores time factor and investment:** The marginal cost of two jobs may be the same but the time taken for their completion and the cost of machines used may differ. The true cost of a job which takes longer time and uses costlier machine would be higher. This fact is not disclosed by marginal costing.
7. **Understating of W-I-P:** Under marginal costing stocks and work in progress are understated.

12.6 Cost-Volume-Profit Analysis

Meaning: It is a managerial tool showing the relationship between various ingredients of profit planning viz., cost, selling price and volume of activity. As the name suggests, cost volume profit (CVP) analysis is the analysis of three variables cost, volume and profit. Such an analysis explores the relationship between costs, revenue, activity levels and the resulting profit. It aims at measuring variations in cost and volume.

Assumptions:

1. Changes in the levels of revenues and costs arise only because of changes in the number of product (or service) units produced and sold – for example, the number of television sets produced and sold by Sony Corporation or the number of packages delivered by Overnight Express. The number of output units is the only revenue driver and the only cost driver. Just as a cost driver is any factor that affects costs, a revenue driver is a variable, such as volume, that causally affects revenues.
2. Total costs can be separated into two components; a fixed component that does not vary with output level and a variable component that changes with respect to output level. Furthermore, variable costs include both direct variable costs and indirect variable costs of a product. Similarly, fixed costs include both direct fixed costs and indirect fixed costs of a product

3. When represented graphically, the behaviours of total revenues and total costs are linear (meaning they can be represented as a straight line) in relation to output level within a relevant range (and time period).
4. Selling price, variable cost per unit, and total fixed costs (within a relevant range and time period) are known and constant.
5. The analysis either covers a single product or assumes that the proportion of different products when multiple products are sold will remain constant as the level of total units sold changes.
6. All revenues and costs can be added, subtracted, and compared without taking into account the time value of money. (Refer to the FM study material for a clear understanding of time value of money).

Importance

It provides the information about the following matters:

1. The behavior of cost in relation to volume.
2. Volume of production or sales, where the business will break-even.
3. Sensitivity of profits due to variation in output.
4. Amount of profit for a projected sales volume.
5. Quantity of production and sales for a target profit level.

Impact of various changes on profit:

An understanding of CVP analysis is extremely useful to management in budgeting and profit planning. It elucidates the impact of the following on the net profit:

- (i) *Changes in selling prices,*
- (ii) *Changes in volume of sales,*
- (iii) *Changes in variable cost,*
- (iv) *Changes in fixed cost.*

12.6.1 Marginal Cost Equation: The contribution theory explains the relationship between the variable cost and selling price. It tells us that selling price minus variable cost of the units sold is the contribution towards fixed expenses and profit. If the contribution is equal to fixed expenses, there will be no profit or loss and if it is less than fixed expenses, loss is incurred. Since the variable cost varies in direct proportion to output, therefore if the firm does not produce any unit, the loss will be there to the extent of fixed expenses. These points can be described with the help of following marginal cost equation: $S - V = C = F \pm P$

Where,

S = Selling price per unit, V = Variable cost per unit, C – Contribution, F = Fixed Cost,

P = Profit/Loss

12.15 Cost Accounting

Marginal Cost Statement		(₹)
Sales		XXXX
Less: Variable Cost		XXXX
Contribution		XXXX
Less: Fixed Cost		XXXX
Profit		XXXX

12.6.2 Contribution to Sales Ratio (Profit Volume Ratio or P/V ratio)

This ratio is usually expressed in percentage.

$$P/V \text{ Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100 \quad \text{or, } P/V \text{ Ratio} = \frac{\text{Change in contribution / Profit}}{\text{Change in sales}} \times 100$$

A higher contribution to sales ratio implies that the rate of growth of contribution is faster than that of sales. This is because, once the breakeven point is reached, profits shall grow at a faster rate when compared to a product with a lesser contribution to sales ratio.

By transposition, we have derived the following equations:

(i) $C = S \times P/V \text{ ratio}$

(ii) $S = \frac{C}{P/V \text{ Ratio}}$

12.6.3 Break-Even Analysis: Break-even analysis is a generally used method to study the CVP analysis. This technique can be explained in two ways:

- (i) In narrow sense it is concerned with computing the break-even point. At this point of production level and sales there will be no profit and loss i.e. total cost is equal to total sales revenue.
- (ii) In broad sense this technique is used to determine the possible profit/loss at any given level of production or sales.

12.7 Methods of Break -Even Analysis

Break even analysis may be conducted by the following two methods:

- (i) Algebraic computations
- (ii) Graphic presentations

12.8 Algebraic Calculations

12.8.1 Breakeven Point: The word contribution has been given its name because of the fact that it literally contributes towards the recovery of fixed costs and the making of profits.

The contribution grows along with the sales revenue till the time it just covers the fixed cost. This point where neither profits nor losses have been made is known as a break-even point. This implies that in order to break even the amount of contribution generated should be exactly equal to the fixed costs incurred. Hence, if we know how much contribution is generated from each unit sold we shall have sufficient information for computing the number of units to be sold in order to break even. Mathematically,

$$\text{Break- even point in units} = \frac{\text{Fixed costs}}{\text{Contribution per unit}}$$

Let us consider an example of a company (ABC Ltd) manufacturing a single product, incurring variable costs of ₹ 300 per unit and fixed costs of ₹ 2, 00,000 per month. If the product sells for ₹ 500 per unit, the breakeven point shall be calculated as follows;

$$\text{Break- even point in units} = \frac{\text{Fixed costs}}{\text{Contribution per unit}} = \frac{\text{₹ } 2,00,000}{\text{₹ } 200} = 1,000 \text{ units}$$

$$\text{Break- even points (in Rupees)} = \frac{\text{Total fixed cost}}{\text{Contribution}} \times \text{Sales}$$

$$\text{Break- even point (in Rupees)} = \frac{\text{Total fixed cost}}{P / V \text{ Ratio}}$$

12.8.2 Cash Break-even point: When break-even point is calculated only with those fixed costs which are payable in cash, such a break-even point is known as cash break-even point. This means that depreciation and other non-cash fixed costs are excluded from the fixed costs in computing cash break-even point. Its formula is –

$$\text{Cash break- even point} = \frac{\text{Cash fixed costs}}{\text{Contribution per unit}}$$

Illustration 3 (Calculation of BEP and sales)

You are given the following particulars calculate:

- (a) Break-even point
- (b) Sales to earn a profit of ₹ 20,000
 - i. Fixed cost ₹ 1,50,000
 - ii. Variable cost ₹ 15 per unit
 - iii. Selling price is ₹ 30 per unit

Solution:

$$\begin{aligned} \text{(a) B.E.P} &= \text{Fixed Cost} / \text{Contribution per unit*} \\ &= ₹ 1,50,000 \div ₹ 15 = 10,000 \text{ Units} \end{aligned}$$

12.17 Cost Accounting

* (Contribution per unit = Sales per unit – Variable cost per unit = ₹ 30 - ₹15)

(b) Sales to earn a Profit of ₹ 20,000 = (FC + Desired Profit)/ Contribution per unit x S.P.

$$= (\text{₹}1,50,000 + \text{₹}20,000) \div 15 \times 30$$

$$= \text{₹}1,70,000 \div 15 \times 30$$

$$= \text{₹} 3,40,000 \text{ or, } \frac{\text{₹}1,70,000}{\text{P/V Ratio}} = \frac{\text{₹}1,70,000}{50\%} = \text{₹} 3,40,000$$

$$\text{PV Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100$$

Illustration 4 (Treatment of commission in computing sales price and calculation of Break Even Point)

A Chinese soft drink company is planning to establish a subsidiary company in India to produce mineral water. Based on the estimated annual sales of 40,000 bottles of the mineral water, cost studies produced the following estimates for the Indian subsidiary:

	Total annual costs	Percent of Total Annual Cost which is variable
Material	2,10,000	100%
Labour	1,50,000	80%
Factory Overheads	92,000	60%
Administration Expenses	40,000	35%

The Indian production will be sold by manufacturer's representatives who will receive a commission of 8% of the sale price. No portion of the Chinese office expenses is to be allocated to the Indian subsidiary. You are required to

(i) Compute the sale price per bottle to enable the management to realize an estimated 10% profit on sale proceeds in India.

(ii) Calculate the break-even point in Rupee sales as also in number of bottles for the Indian subsidiary on the assumption that the sale price is ₹ 14 per bottle.

Answer

(i) Computation of Sale Price Per Bottle

Output: 40,000 Bottles

(₹)	
Variable Cost:	
Material	2,10,000
Labour (₹1,50,000 × 80%)	1,20,000

Factory Overheads (₹92,000 × 60%)	55,200
Administrative Overheads (₹40,000 × 35%)	14,000
Commission (8% on ₹6,00,000) (W.N.-1)	48,000
Fixed Cost:	
Labour (₹1,50,000 × 20%)	30,000
Factory Overheads (₹92,000 × 40%)	36,800
Administrative Overheads (₹40,000 × 65%)	26,000
Total Cost	5,40,000
Profit (W.N.-1)	60,000
Sales Proceeds (W.N.-1)	6,00,000
Sales Price per bottle $\left(\frac{₹6,00,000}{40,000 \text{ Bottles}} \right)$	15

(ii) Calculation of Break-even Point

Sales Price per Bottle	=	₹14
Variable Cost per Bottle	=	$\frac{₹4,44,000 \text{ (W.N. - 2)}}{40,000 \text{ Bottles}}$
	=	₹11.10
Contribution per Bottle	=	₹14 – ₹11.10
	=	₹2.90
Break -even Point		
(in number of Bottles)	=	$\frac{\text{Fixed Costs}}{\text{Contribution per Bottle}}$
	=	$\frac{₹92,800}{₹2.90} = 32,000 \text{ Bottles}$
Break- even Point		
(in Sales Value)	=	32,000 Bottles × ₹14
	=	₹4,48,000

Working Note

W.N.-1

Let the Sales Price be 'x'

$$\text{Commission} = \frac{8x}{100}$$

12.19 Cost Accounting

$$\begin{aligned}\text{Profit} &= \frac{10x}{100} \\ x &= 4,92,000 + \frac{8x}{100} + \frac{10x}{100} \\ 100x - 8x - 10x &= 4,92,00,000 \\ 82x &= 4,92,00,000 \\ x &= 4,92,00,000 / 82 \\ &= ₹6,00,000\end{aligned}$$

W.N.-2

Total Variable Cost	(₹)
Material	2,10,000
Labour	1,20,000
Factory Overheads	55,200
Administrative Overheads	14,000
Commission [(40,000 Bottles × ₹14) × 8%]	44,800
	4,44,000

Illustration 5 (Calculation of selling price)

If P/V ratio is 60% and the Marginal cost of the product is ₹ 20. What will be the selling price?

Solution:

$$\begin{aligned}\text{Variable Cost} &= 100 - \text{P/V Ratio} \\ &= 100 - 60 = 40\end{aligned}$$

If Variable cost is 40, then selling price = 100

If Variable cost is 20, then selling price = $(100/40) \times 20 = ₹ 50$

Illustration 6 (Calculation of capacity sales)

The ratio of variable cost to sales is 70%. The break-even point occurs at 60% of the capacity sales. Find the capacity sales when fixed costs are ₹ 90,000. Also compute profit at 75% of the capacity sales.

Solution:

Variable cost to sales = 70%, Contribution to sales = 30%,

Or P/V Ratio 30%

We know that: $\text{BES} \times \text{P/V Ratio} = \text{Fixed Cost}$

$$\text{BES} \times 0.30 = ₹ 90,000$$

$$\text{Or BES} = ₹ 3,00,000$$

It is given that break-even occurs at 60% capacity.

Capacity sales = ₹ 3,00,000 ÷ 0.60 = ₹ 5,00,000

Computation of profit of 75% Capacity

75% of capacity sales (i.e. ₹ 5,00,000 × 0.75)	= ₹ 3,75,000
Less: Variable cost (i.e. ₹ 3,75,000 × 0.70)	= ₹ <u>2,62,500</u>
	= ₹ 1,12,500
Less: Fixed Cost	= ₹ <u>90,000</u>
Profit	= ₹ <u>22,500</u>

Illustration 7 (Calculation of sales)

A company has a P/V ratio of 40%. By what percentage must sales be increased to offset: 20% reduction in selling price?

Solution:

Suppose - Sales = (100 units @ ₹ 1 each)	100
Less: Contribution (40% of sales)	<u>40</u>
Variable Cost	<u>60</u>
When selling price reduced by 20%	(₹)
New Sales	80
Less: Variable Cost	<u>60</u>
New Contribution	<u>20</u>

In order to maintain the same contribution, the volume of sales should be

$$= (40 \div 20) \times 80 = ₹ 160$$

Thus, if selling price reduced by 20%, the sales will have to be increased by 60% i.e. from ₹ 100 to ₹ 160.

Illustration 8 (Calculation of sales, fixed cost and P/V ratio)

PQR Ltd. has furnished the following data for the two years :

	2013	2014
Sales	₹ 8,00,000	?
Profit/Volume Ratio (P/V ratio)	50%	37.5%
Margin of Safety sales as a % of total sales	40%	21.875%

There has been substantial savings in the fixed cost in the year 2014 due to the restructuring process. The company could maintain its sales quantity level of 2013 in 2014 by reducing selling price.

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You are required to calculate the following:

- (i) Sales for 2014 in ₹
- (ii) Fixed cost for 2014
- (iii) Break-even sales for 2014 in Rupees.

Solution:

In 2013, PV ratio = 50%

Variable cost ratio = 100% - 50% = 50%

Variable cost in 2013 = ₹ 8,00,000 × 50% = ₹ 4,00,000

In 2014, sales quantity has not changed. Thus variable cost in 2014 is ₹ 4,00,000.

In 2014, P/V ratio = 37.50%

Thus, Variable cost ratio = 100% - 37.5% = 62.5%

(i) Thus sales in 2014 = $\frac{4,00,000}{62.5\%} = ₹6,40,000$

At break-even point, fixed costs is equal to contribution.

In 2014, Break-even sales = 100% - 21.875% = 78.125%

(ii) Break-even sales = 6,40,000 × 78.125% = ₹ 5,00,000

(iii) Fixed cost = B.E. sales × P/V ratio
= 5,00,000 × 37.50% = ₹1,87,500.

Illustration 9 (Calculation of profit and sales)

		(₹)
(i)	Ascertain profit, when sales	= 2,00,000
	Fixed Cost	= 40,000
	BEP	= 1,60,000
(ii)	Ascertain sales, when fixed cost	= 20,000
	Profit	= 10,000
	BEP	= 40,000

Solution:

(i) We know that: B.E. Sales × P/V Ratio = Fixed Cost

or ₹ 1,60,000 × P/V ratio = ₹ 40,000

P/V ratio = 25%

We also know that Sales × P/V Ratio = Fixed Cost + Profit

or ₹ 2,00,000 × 0.25 = ₹ 40,000 + Profit

or Profit = ₹ 10,000

(ii) Again B.E. Sales \times P/V ratio = Fixed Cost

or ₹ 40,000 \times P/V Ratio = ₹ 20,000

or P/V ratio = 50%

We also know that: Sales \times P/V ratio = Fixed Cost + Profit

or Sales \times 0.50 = ₹ 20,000 + ₹ 10,000

or Sales = ₹ 60,000.

Illustration 10 (Calculation of fixed cost and sales)

A company has three factories situated in north, east and south with its Head Office in Mumbai. The management has received the following summary report on the operations of each factory for a period:

(₹ in '000)

	Sales		Profit	
	Actual	Over/(Under) Budget	Actual	Over/(Under) Budget
North	1,100	(400)	135	(180)
East	1,450	150	210	90
South	1,200	(200)	330	(110)

Calculate for each factory and for the company as a whole for the period :

(i) the fixed costs. (ii) break-even sales.

Solution:

Calculation of P/V Ratio

(₹'000)

	Sales	Profit
North : Actual	1,100	135
Add : Under budgeted	<u>400</u>	<u>180</u>
Budgeted	<u>1,500</u>	<u>315</u>

$$\text{P/V ratio} = \frac{\text{Difference in Profit}}{\text{Difference in Sales}} = \frac{315 - 135}{1,500 - 1,100} = \frac{180}{400} \times 100 = 45\%$$

(₹'000)

	Sales	Profit
East : Actual	1,450	210
Less : Over budgeted	<u>150</u>	<u>90</u>

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Budgeted	<u>1,300</u>	<u>120</u>
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$$\text{P/V ratio} = \frac{90}{150} \times 100 = 60\%$$

(₹'000)

	Sales	Profit
South : Actual	1,200	330
Add : Under budgeted	<u>200</u>	<u>110</u>
Budgeted	<u>1,400</u>	<u>440</u>

$$\text{P/V ratio} = \frac{110}{200} \times 100 = 55\%$$

Calculation of fixed cost

Fixed Cost	= (Actual sales × P/V ratio) – Profit
North	= (1,100 × 45%) – 135 = 360
East	= (1,450 × 60%) – 210 = 660
South	= (1,200 × 55%) – 330 = <u>330</u>
Total Fixed Cost	<u>1,350</u>

Calculation of break-even sales (in ₹'000)

B.E. Sales	= $\frac{\text{Fixed Cost}}{\text{P/V ratio}}$
North	= $\frac{360}{45\%}$ = 800
East	= $\frac{660}{60\%}$ = 1,100
South	= $\frac{330}{55\%}$ = <u>600</u>
Total	<u>2,500</u>

Illustration 11 (Calculation of break- even point)

A company sells its product at ₹ 15 per unit. In a period, if it produces and sells 8,000 units, it incurs a loss of ₹ 5 per unit. If the volume is raised to 20,000 units, it earns a profit of ₹ 4 per unit. Calculate break-even point both in terms of rupees as well as in units.

Solution:

We know that $S - V = F + P$

∴ Suppose variable cost = x, Fixed Cost = y

In first situation :

$$15 \times 8,000 + 8,000x = y - 40,000 \quad (1)$$

In second situation :

$$15 \times 20,000 + 20,000x = y + 80,000 \quad (2)$$

$$\text{or, } 1,20,000 - 8,000x = y - 40,000 \quad (3)$$

$$3,00,000 - 20,000x = y + 80,000 \quad (4)$$

From (3) & (4) we get $x = ₹ 5$, Variable cost per unit = ₹ 5

Putting this value in 3rd equation:

$$1,20,000 - (8,000 \times 5) = y - 40,000$$

$$\text{or, } y = ₹ 1,20,000$$

$$\text{Fixed Cost} = ₹ 1,20,000$$

$$\text{P/V ratio} = \frac{S - V}{S} = \frac{15 - 5}{15} \times 100 = \frac{200}{3} = 66\frac{2}{3}\%$$

Suppose break-even sales = x

$$15x - 5x = 1,20,000 \quad (\text{at BEP, contribution will be equal to fixed cost})$$

$$x = 12,000 \text{ units.}$$

or, Break-even sales in units = 12,000, Break-even sales in rupees = $12,000 \times 15 = ₹ 1,80,000$.

Illustration 12 (Calculation of break- even point)

The product mix of a Gama Ltd. is as under:

	Products	
	M	N
Units	54,000	18,000
Selling price	₹ 7.5	₹ 15
Variable cost	₹ 6	₹ 4.5

Find the break-even points in units, if the company discontinues product 'M' and replace with product 'O'. The quantity of product 'O' is 9,000 units and its selling price and variable costs respectively are ₹ 18 and ₹ 9. Fixed Cost is ₹ 15,000.

Solution:

$$N = 18,000 \text{ units}$$

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O	=	9,000 units
Ratio (N : O)	=	2:1
Let		
t	=	No. of units of 'O' for BEP
N	=	2t No. of units for BEP
Contribution of 'N'	=	₹10.5 per unit
Contribution of 'O'	=	₹9 per unit
At Break Even Point:		
$\Rightarrow 10.5 \times (2t) + 9 \times t - 15,000$	=	0
$\Rightarrow 30t$	=	15,000
$\Rightarrow t$	=	500 units
BEP of 'N'	=	2t
	=	1,000 units
BEP of 'O'	=	t
	=	500 units

Illustration 13 (Calculation of break- even point and sales)

Mr. X has ₹ 2,00,000 investments in his business firm. He wants a 15 per cent return on his money. From an analysis of recent cost figures, he finds that his variable cost of operating is 60 per cent of sales, his fixed costs are ₹ 80,000 per year. Show computations to answer the following questions:

- What sales volume must be obtained to break even?
- What sales volume must be obtained to get 15 per cent return on investment?
- Mr. X estimates that even if he closed the doors of his business, he would incur ₹ 25,000 as expenses per year. At what sales would he be better off by locking his business up?

Solution:

	(₹)
Suppose sales	100
Variable cost	<u>60</u>
Contribution	<u>40</u>
P/V ratio	40%
Fixed cost	= ₹ 80,000

- (i) Break-even point = Fixed Cost ÷ P/V ratio = 80,000 ÷ 40% or ₹ 2,00,000

- | | | |
|-------|---------------------------------------------------------------------------|-----------------|
| (ii) | 15% return on ₹ 2,00,000 | 30,000 |
| | Fixed Cost | <u>80,000</u> |
| | Contribution required | <u>1,10,000</u> |
| | Sales volume required = ₹ 1,10,000 ÷ 40% or ₹ 2,75,000 | |
| (iii) | Fixed cost even if business is locked up = ₹ 25,000 | |
| | Minimum sales required to meet this cost: ₹ 25,000 ÷ 40% or ₹ 62,500 | |
| | Mr. X will be better off if the sale is more than ₹ 62,500. | |

12.9 Margin of Safety

The margin of safety can be defined as the difference between the expected level of sale and the breakeven sales. The larger the margin of safety, the higher is the chances of making profits. In the above example if the forecast sale is 1,700 units per month, the margin of safety can be calculated as follows,

Margin of Safety = Projected sales – Breakeven sales

$$= 1,700 \text{ units} - 1,000 \text{ units}$$

$$= 700 \text{ units or } 41 \% \text{ of sales.}$$

The Margin of Safety can also be calculated by identifying the difference between the projected sales and breakeven sales in units multiplied by the contribution per unit. This is possible because, at the breakeven point all the fixed costs are recovered and any further contribution goes into the making of profits. It also can be calculated as

$$\frac{P}{P/V \text{ ratio}}$$

12.10 Variations of Basic Marginal Cost Equation and other formulae

- i. Sales – Variable cost = Fixed cost ± Profit/ Loss

By multiplying and dividing L.H.S. by S

$$\text{ii. } \frac{S(S - V)}{S} = F + P$$

$$\text{iii. } S \times P/V \text{ Ratio} = F + P \text{ or Contribution} \quad \left(\because P/V \text{ Ratio} = \frac{S - V}{S} \right)$$

$$\text{iv. } \text{BES} \times P/V \text{ Ratio} = F \quad (\because \text{at BEP profit is zero})$$

$$\text{v. } \text{BES} = \frac{\text{Fixed Cost}}{P/V \text{ Ratio}}$$

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- vi. $P/V \text{ Ratio} = \frac{\text{Fixed cost}}{\text{BES}}$
- vii. $S \times P/V \text{ Ratio} = \text{Contribution (Refer to iii)}$
- viii. $P/V \text{ Ratio} = \frac{\text{Contribution}}{\text{Sales}}$
- ix. $(\text{BES} + \text{MS}) \times P/V \text{ Ratio} = \text{contribution (Total sales} = \text{BES} + \text{MS})$
- x. $(\text{BES} \times P/V \text{ Ratio}) + (\text{MS} \times P/V \text{ Ratio}) = F + P$
By deducting $(\text{BES} \times P/V \text{ Ratio})$ from L.H.S. and F from R.H.S. in x we get :
- xi. $\text{M.S.} \times P/V \text{ Ratio} = P$
- xii. $P/V \text{ Ratio} = \frac{\text{Change in profit}}{\text{Change in sales}}$
- xiii. $P/V \text{ Ratio} = \frac{\text{Change in contribution}}{\text{Change in sales}}$
- xiv. $\text{Profitability} = \frac{\text{Contribution}}{\text{Key factor}}$
- xv. $\text{Margin of Safety} = \text{Total Sales} - \text{BES or } \frac{\text{Profit}}{P/V \text{ ratio}}$
- xvi. $\text{BES} = \text{Total Sales} - \text{MS}$
 $\text{Margin of Safety Ratio} = \frac{\text{Total sales} - \text{BES}}{\text{Total sales}}$

Illustration 14 (Application of marginal cost equation)

An automobile manufacturing company produces different models of Cars. The budget in respect of model 007 for the month of March, 2015 is as under:

Budgeted Output		40,000 Units
	₹ In lakhs	₹ In lacs
Net Realisation		700
Variable Costs:		
Materials	264	
Labour	52	
Direct expenses	<u>124</u>	440
Specific Fixed Costs	90	
Allocated Fixed Costs	112.50	202.50
Total Costs		642.50

<i>Profit</i>	57.50
<i>Sales</i>	700.00

Calculate:

- (i) *Profit with 10 percent increase in selling price with a 10 percent reduction in sales volume.*
- (ii) *Volume to be achieved to maintain the original profit after a 10 percent rise in material costs, at the originally budgeted selling price per unit.*

Answer

- (i) Budgeted selling price = 700 lakhs/ 40,000 units = ₹ 1,750 per unit.

Budgeted variable cost = 440 lakhs/ 40,000 units = ₹ 1,100 per unit.

Increased selling price = 1,750 + 10% = ₹ 1,925 per unit

New volume 40,000 – 10% = 36,000 units

Statement of Calculation of Profit

	(₹ In lakhs)
Sales 36,000 units at ₹ 1,925 =	693.00
Less: Variable cost: 36,000 × 1,100 =	<u>396.00</u>
Contribution	297.00
Less: fixed costs	<u>202.50</u>
Profit	<u>94.50</u>

- (ii) Budgeted Material cost = 264 lakhs/ 40,000 units = ₹ 660 per unit

Increased material cost = 660 × 10% = 726

Labour cost 52 lakhs/ 40,000 units = 130

Direct expenses, 124 lakhs/ 40,000 units = 310

Variable cost per unit 1166

Budgeted selling price per unit 1750

Contribution per unit(1,750 – 1,166) 584

$$\text{Sales volume} = \frac{\text{Fixed costs} + \text{Profit}}{\text{Contribution Per Unit}} = \frac{202.50 \text{ lakhs} + 57.50 \text{ lakhs}}{\text{₹ 584}}$$

= 44,521 units are to be sold to maintain the original profit of ₹ 57.50 lakhs.

Illustration 15 (Calculation of margin of safety)

A company earned a profit of ₹ 30,000 during the year 2014. If the marginal cost and selling price of the product are ₹ 8 and ₹ 10 per unit respectively, find out the amount of margin of

12.29 Cost Accounting

safety.

Solution:

$$\text{P/V ratio} = \frac{S - V}{S} = \frac{10 - 8}{10} = 20\%$$

$$\text{Margin of safety} = \frac{\text{Profit}}{\text{P/V ratio}} = \frac{30,000}{20\%} = ₹ 1,50,000$$

Illustration 16 (Calculation of margin of safety)

A Ltd. Maintains margin of safety of 37.5% with an overall contribution to sales ratio of 40%. Its fixed costs amount to ₹ 5 lakhs.

Calculate the following:

- i. Break-even sales
- ii. Total sales
- iii. Total variable cost
- iv. Current profit
- v. New 'margin of safety' if the sales volume is increased by 7 ½ %.

Solution:

- (i) We know that: Break Even Sales (BES) x P/V Ratio = Fixed Cost

$$\text{Break Even Sales (BES)} \times 40\% = ₹ 5,00,000$$

$$\text{Break Even Sales (BES)} = ₹ 12,50,000$$

- (ii) Total Sales = Break Even Sales + Margin of Safety

$$S = ₹ 12,50,000 + 0.375S$$

$$S - 0.375S = ₹ 12,50,000$$

$$S = ₹ 20,00,000$$

- (iii) Contribution to Sales Ratio = 40%

Therefore, Variable cost to Sales Ratio = 60%

$$\text{Variable cost} = 60\% \text{ of sales}$$

$$= 60\% \text{ of } 20,00,000$$

$$\text{Variable cost} = 12,00,000$$

- (iv) Current Profit = Sales – (Variable Cost + Fixed Cost)

$$= ₹ 20,00,000 - (12,00,000 + 5,00,000) = ₹ 3,00,000$$

- (v) If sales value is increased by 7 ½ %

$$\text{New Sales value} = ₹ 20,00,000 \times 1.075 = ₹ 21,50,000$$

$$\text{New Margin of Safety} = \text{New Sales value} - \text{BES}$$

$$= ₹ 21,50,000 - ₹ 12,50,000 = ₹ 9,00,000$$

Illustration 17 (Calculation of margin of safety)

You are given the following data :

	Sales	Profit
Year 2013	₹ 1,20,000	8,000
Year 2014	₹ 1,40,000	13,000

Find out –

- (i) P/V ratio,
- (ii) B.E. Point,
- (iii) Profit when sales are ₹1,80,000,
- (iv) Sales required earn a profit of ₹12,000,
- (v) Margin of safety in year 2014.

Solution:

	Sales	Profit
Year 2013	₹ 1,20,000	8,000
Year 2014	₹ 1,40,000	13,000
Difference	₹ 20,000	5,000

$$(i) \text{ P/V Ratio} = \frac{\text{Difference in profit}}{\text{Difference in Sales}} \times 100 = \frac{5,000}{20,000} \times 100 = 25 \%$$

(₹)

Contribution in 2013 (1,20,000 × 25%)	30,000
Less : Profit	<u>8,000</u>
Fixed Cost*	<u>22,000</u>

$$* \text{Contribution} = \text{Fixed cost} + \text{Profit}$$

$$\therefore \text{Fixed cost} = \text{Contribution} - \text{Profit}$$

$$(ii) \text{ Break-even point} = \frac{\text{Fixed cost}}{\text{P/V ratio}} = \frac{22,000}{25\%} = ₹ 88,000$$

$$(iii) \text{ Profit when sales are ₹1,80,000} \quad (\text{₹})$$

Contribution (₹1,80,000 × 25%)	45,000
Less: Fixed cost	<u>22,000</u>
Profit	<u>23,000</u>

$$(iv) \text{ Sales to earn a profit of ₹12,000}$$

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$$\frac{\text{Fixed cost} + \text{Desired profit}}{\text{P/V ratio}} = \frac{22,000 + 12,000}{25\%} = ₹1,36,000$$

(v) Margin of safety in 2014 –

$$\begin{aligned}\text{Margin of safety} &= \text{Actual sales} - \text{Break-even sales} \\ &= 1,40,000 - 88,000 = ₹ 52,000.\end{aligned}$$

Illustration 18 (Calculation of selling price)

A single product company sells its product at ₹ 60 per unit. In 2013, the company operated at a margin of safety of 40%. The fixed costs amounted to ₹ 3,60,000 and the variable cost ratio to sales was 80%.

In 2014, it is estimated that the variable cost will go up by 10% and the fixed cost will increase by 5%.

- (i) Find the selling price required to be fixed in 2014 to earn the same P/V ratio as in 2013.
- (ii) Assuming the same selling price of ₹ 60 per unit in 2014, find the number of units required to be produced and sold to earn the same profit as in 2013.

Solution:

(i) Profit earned in 2013

	(₹)
Total contribution (50,000 × ₹ 12)	6,00,000
Less: Fixed cost	<u>3,60,000</u>
	<u>2,40,000</u>

Selling price to be fixed in 2014

Revised variable cost (₹ 48 × 1.10) 52.80

Revised fixed cost (3,60,000 × 1.05) 3,78,000

P/V Ratio (Same as of 2013) 20%

Variable cost ratio to selling price 80%

Therefore revised selling price per unit = ₹ 52.80 ÷ 80% = ₹ 66

(ii) No. of units to be produced and sold in 2014 to earn the same profit

We know that Fixed Cost plus profit = Contribution
(₹)

Profit in 2013 2,40,000

Fixed cost in 2014 3,78,000

Desired contribution in 2014 6,18,000

Contribution per unit = Selling price per unit – Variable cost per unit.

= ₹ 60 – ₹ 52.80 = ₹ 7.20.

No. of units to be produced in 2014 = ₹ 6,18,000 ÷ ₹ 7.20 = 85,834 units.

Workings

1. PV Ratio in 2013

	(₹)
Selling price per unit	60
Variable cost (80% of Selling Price)	<u>48</u>
Contribution	<u>12</u>
P/V Ratio	20%

2. No. of units sold in 2013

Break-even point = Fixed cost ÷ Contribution per unit
 = ₹ 3,60,000 ÷ ₹ 12 = 30,000 units.

Margin of safety is 40%. Therefore, break-even sales will be 60% of units sold.

No. of units sold = Break-even point in units ÷ 60%
 = 30,000 ÷ 60% = 50,000 units.

Illustration 19 (Calculation of margin of safety)

A company has made a profit of ₹ 50,000 during the year 2013-14. If the selling price and marginal cost of the product are ₹ 15 and ₹ 12 per unit respectively, find out the amount of margin of safety.

Solution:

$$\begin{aligned} \text{P/V Ratio} &= \frac{\text{Contribution}}{\text{Sales}} \times 100 \\ &= [(15 - 12)/15] \times 100 \\ &= (3/15) \times 100 = 20\% \\ \text{Marginal of Safety} &= (\text{Profit}) / (\text{P/V Ratio}) \\ &= 50,000 / 20\% = ₹ 2,50,000 \end{aligned}$$

Illustration 20 (Calculation of break even sales)

- (a) *If margin of safety is ₹ 2,40,000 (40% of sales) and P/V ratio is 30% of AB Ltd, calculate its (1) Break even sales, and (2) Amount of profit on sales of ₹9,00,000.*
- (b) *X Ltd. has earned a contribution of ₹2,00,000 and net profit of ₹1,50,000 of sales of ₹ 8,00,000. What is its margin of safety?*

Solution:

$$\begin{aligned} \text{(a) Total Sales} &= 2,40,000 \times \frac{100}{40} = ₹6,00,000 \\ \text{Contribution} &= 6,00,000 \times 30\% = ₹1,80,000 \end{aligned}$$

12.33 Cost Accounting

Profit	= M/S × P/V ratio = 2,40,000 × 30% = ₹72,000
Fixed cost	= Contribution – Profit = 1,80,000 – 72,000 = ₹1,08,000
(1) Break-even Sales	= $\frac{\text{Fixed Cost}}{\text{P/V ratio}} = \frac{1,08,000}{30\%} = ₹3,60,000$
(2) Profit	= (Sales × P/V ratio) – Fixed cost = (9,00,000 × 30%) – 1,08,000 = ₹1,62,000
(b) P/V ratio	= $\frac{\text{Contribution}}{\text{Sales}} = \frac{2,00,000}{8,00,000} = 25\%$
Margin of safety	= $\frac{\text{Profit}}{\text{P/V ratio}} = \frac{1,50,000}{25\%} = ₹ 6,00,000$
<i>Alternatively :</i>	
Fixed cost	= Contribution – Profit = ₹ 2,00,000 – ₹1,50,000 = ₹ 50,000
B.E. Point	= ₹ 50,000 ÷ 25% = ₹ 2,00,000
Margin of Safety	= Actual sales – B.E. sales = 8,00,000 – 2,00,000 = 6,00,000

Illustration 21 (Calculation of break even sales and margin of safety)

A company had incurred fixed expenses of ₹ 4,50,000, with sales of ₹ 15,00,000 and earned a profit of ₹ 3,00,000 during the first half year. In the second half, it suffered a loss of ₹ 1,50,000.

Calculate:

- The profit-volume ratio, break-even point and margin of safety for the first half year.
- Expected sales volume for the second half year assuming that selling price and fixed expenses remained unchanged during the second half year.
- The break-even point and margin of safety for the whole year.

Solution:

- In the First half year
Contribution = Fixed cost + Profit
= 4,50,000 + 3,00,000 = ₹ 7,50,000

$$\text{P/V ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100 = \frac{7,50,000}{15,00,000} \times 100 = 50\%$$

$$\text{Break-even point} = \frac{\text{Fixed cost}}{\text{P/V ratio}} = \frac{4,50,000}{50\%} \times 100 = ₹ 9,00,000$$

$$\begin{aligned} \text{Margin of safety} &= \text{Actual sales} - \text{Break-even point} \\ &= 15,00,000 - 9,00,000 = ₹ 6,00,000 \end{aligned}$$

(ii) In the second half year

$$\begin{aligned} \text{Contribution} &= \text{Fixed cost} - \text{Loss} \\ &= 4,50,000 - 1,50,000 = ₹ 3,00,000 \end{aligned}$$

$$\text{Expected sales volume} = \frac{\text{Fixed cost} - \text{Loss}}{\text{P/V ratio}} = \frac{3,00,000}{50\%} = ₹ 6,00,000$$

(iii) For the whole year

$$\text{B.E. point} = \frac{\text{Fixed cost}}{\text{P/V ratio}} = \frac{4,50,000 \times 2}{50\%} = ₹ 18,00,000$$

$$\text{Margin of safety} = \frac{\text{Profit}}{\text{P/V ratio}} = \frac{3,00,000 - 1,50,000}{50\%} = ₹ 3,00,000.$$

Illustration 22 (Calculation of Break even Sales, Profit, and Fixed Cost)

The following information is given by Star Ltd.:

Margin of Safety	₹ 1,87,500
Total Cost	₹ 1,93,750
Margin of Safety	3,750 units
Break-even Sales	1,250 units

Required:

Calculate Profit, P/V Ratio, BEP Sales (in ₹) and Fixed Cost.

Solution:

$$\begin{aligned} \text{Margin of Safety (\%)} &= \\ &= \frac{3,750 \text{ units}}{3,750 \text{ units} + 1,250 \text{ units}} \\ &= 75\% \end{aligned}$$

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$$\begin{aligned}\text{Total Sales} &= \frac{₹1,87,500}{0.75} \\ &= ₹2,50,000 \\ \text{Profit} &= \text{Total Sales} - \text{Total Cost} \\ &= ₹2,50,000 - ₹1,93,750 \\ &= ₹56,250 \\ \text{P/V Ratio} &= \frac{\text{Profit}}{\text{Margin of Safety (₹)}} \times 100 \\ &= \frac{₹56,250}{₹1,87,500} \times 100 \\ &= 30\% \\ \text{Break-even Sales} &= \text{Total Sales} \times [100 - \text{Margin of Safety \%}] \\ &= ₹2,50,000 \times 0.25 \\ &= ₹62,500 \\ \text{Fixed Cost} &= \text{Sales} \times \text{P/V Ratio} - \text{Profit} \\ &= ₹2,50,000 \times 0.30 - ₹56,250 \\ &= ₹18,750\end{aligned}$$

Illustration 23 (Implication of changes in different variables on P/V ratio)

By noting “P/V will increase or P/V will decrease or P/V will not change”, as the case may be, state how the following independent situations will affect the P/V ratio:

- (i) An increase in the physical sales volume;
- (ii) An increase in the fixed cost;
- (iii) A decrease in the variable cost per unit;
- (iv) A decrease in the contribution margin;
- (v) An increase in selling price per unit;
- (vi) A decrease in the fixed cost;
- (vii) A 10% increase in both selling price and variable cost per unit;
- (viii) A 10% increase in the selling price per unit and 10% decrease in the physical sales volume;
- (ix) A 50% increase in the variable cost per unit and 50% decrease in the fixed cost.
- (x) An increase in the angle of incidence.

Answer

Item no.	P/V Ratio	Reason
(i)	Will not change	
(ii)	Will not change	
(iii)	Will increase	
(iv)	Will decrease	
(v)	Will increase	
(vi)	Will not change	
(vii)	Will not change	Reasoning 1
(viii)	Will increase	Reasoning 2
(ix)	Will decrease	Reasoning 3
(x)	Will increase	Reasoning 4

A 10% increase in both selling price and variable cost per unit.

Reasoning 1. Assumptions: a) Variable cost is less than selling price.

b) Selling price ₹100 variable cost ₹ 90 per unit.

$$c) P/V \text{ ratio} = \frac{100 - 90}{100} = 10\%$$

10% increase in S.P. = ₹110

10% increase in variable cost = ₹99

$$P/V \text{ ratio} = \frac{110 - 99}{10} = 10\% \text{ i.e. } P/v \text{ ratio will not change}$$

Reasoning 2. Increase or decrease in physical sales volume will not change P/v ratio. Hence 10% increase in selling price per unit will increase P/V ratio.

Reasoning 3. Increase or decrease in fixed cost will not change P/V ratio. Hence 50% increase in the variable cost per unit will decrease P/V ratio.

Reasoning 4. Angle of incidence is the angle at which sales line cuts the total cost line. If it is large, it indicates that the profits are being made at higher rate. Hence increase in the angle of incidence will increase the P/V ratio.

12.11 Angle of Incidence

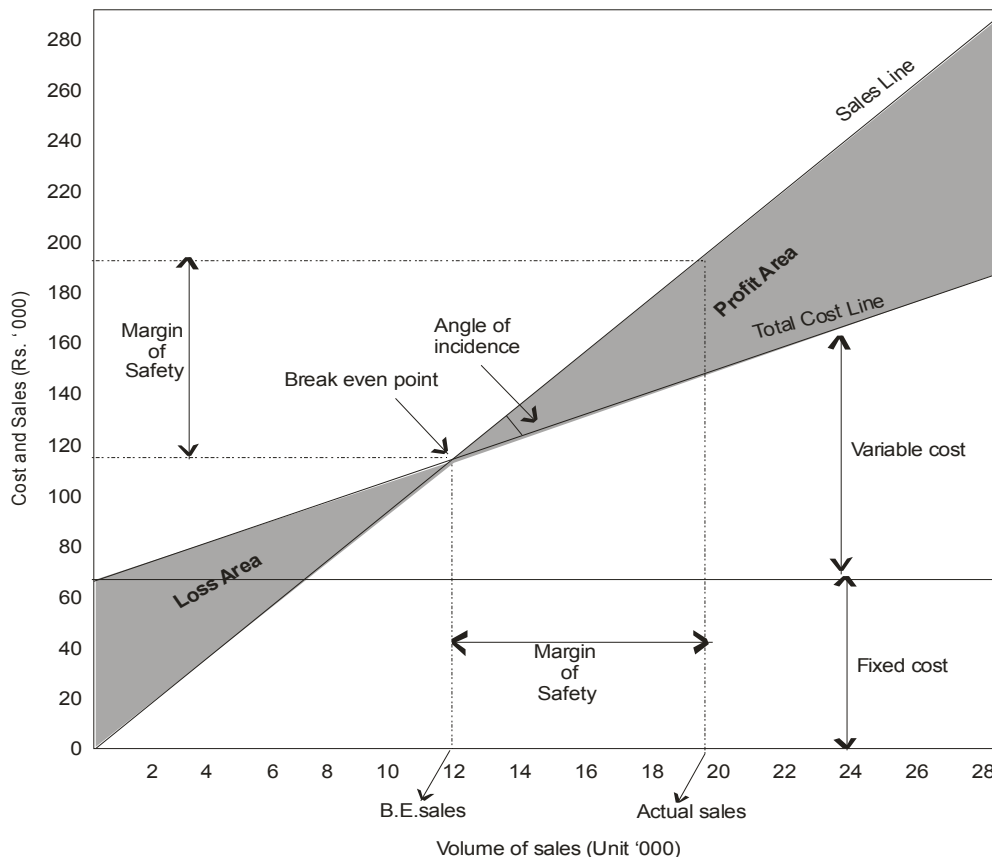
This angle is formed by the intersection of sales line and total cost line at the break-even point. This angle shows the rate at which profits are being earned once the break-even point has been reached. The wider the angle the greater is the rate of earning profits. A large angle of incidence with a high margin of safety indicates extremely favourable position.

12.12 Graphical Representation of Break Even Chart

12.12.1 Break-even Chart : A breakeven chart records costs and revenues on the vertical axis and the level of activity on the horizontal axis. The making of the breakeven chart would require you to select appropriate axes. Subsequently, you will need to mark costs/revenues on the Y axis whereas the level of activity shall be traced on the X axis. Lines representing (i) Fixed costs (horizontal line at ₹ 2,00,000 for ABC Ltd), (ii) Total costs at maximum level of activity (joined to the Y-axis where the Fixed cost of ₹ 2,00,000 is marked) and (iii) Revenue at maximum level of activity (joined to the origin) shall be drawn next.

The breakeven point is that point where the sales revenue line intersects the total cost line. Other measures like the margin of safety and profit can also be measured from the chart.

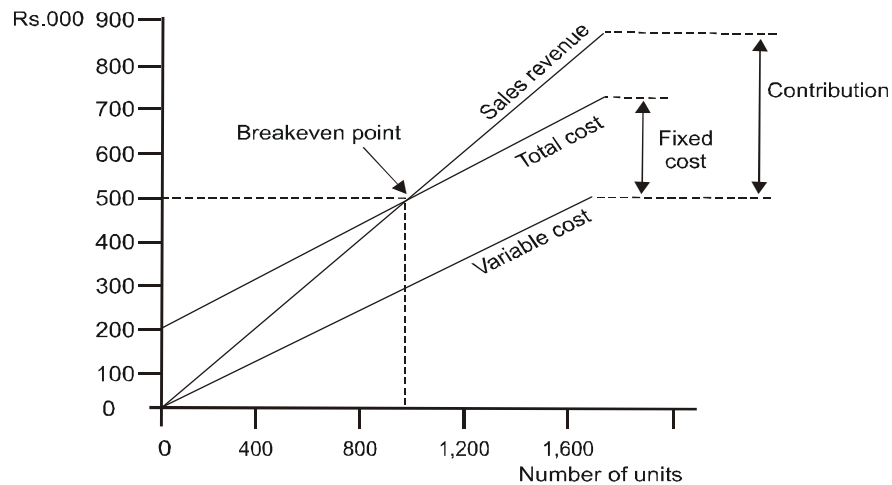
The following breakeven chart depicts the different measures:



12.12.2 Contribution Breakeven chart: It is not possible to use a breakeven chart as described above to measure contribution. This is one of its major limitations especially so

because contribution analysis is literally the backbone of marginal costing. To overcome such a limitation, accountants frequently resort to the making of a contribution breakeven chart which is based on the same principles as a conventional breakeven chart except for that it shows the variable cost line instead of the fixed cost line. Lines for Total cost and Sales revenue remain the same. The breakeven point and profit can be read off in the same way as with a conventional chart. However it is also possible to read the contribution for any level of activity.

Using the same example of ABC Ltd as for the conventional chart, the total variable cost for an output of 1,700 units is $1,700 \times ₹300 = ₹5,10,000$. This point can be joined to the origin since the variable cost is nil at zero activity.

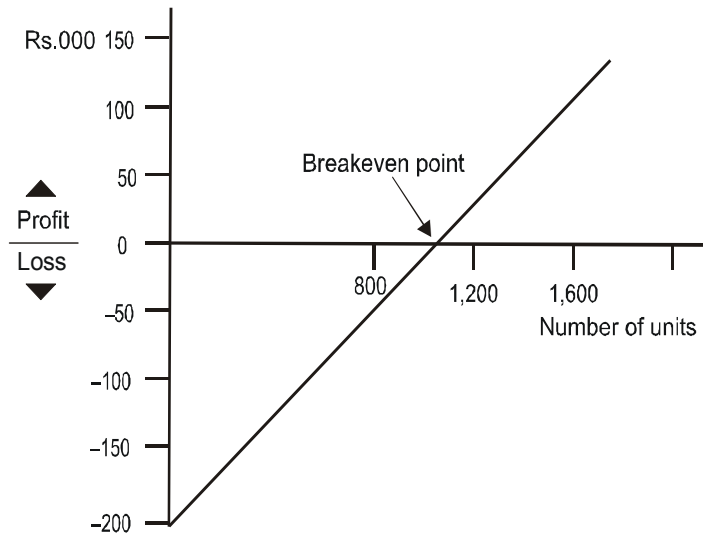


The contribution can be read as the difference between the sales revenue line and the variable cost line.

12.12.3 Profit-volume chart: This is also very similar to a breakeven chart. In this chart the vertical axis represents profits and losses and the horizontal axis is drawn at zero profit or loss.

In this chart each level of activity is taken into account and profits marked accordingly. The breakeven point is where this line intersects the horizontal axis. A profit-volume graph for our example (ABC Ltd) will be as follows,

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The loss at a nil activity level is equal to ₹ 2,00,000, i.e. the amount of fixed costs. The second point used to draw the line could be the calculated breakeven point or the calculated profit for sales of 1,700 units.

Advantages of the profit-volume chart

1. The biggest advantage of the profit-volume chart is its capability of depicting clearly the effect on profit and breakeven point of any changes in the variables. The following example illustrates this characteristic,

Example:

A manufacturing company incurs fixed costs of ₹3,00,000 per annum. It is a single product company with annual sales budgeted to be 70,000 units at a sales price of ₹300 per unit. Variable costs are ₹285 per unit.

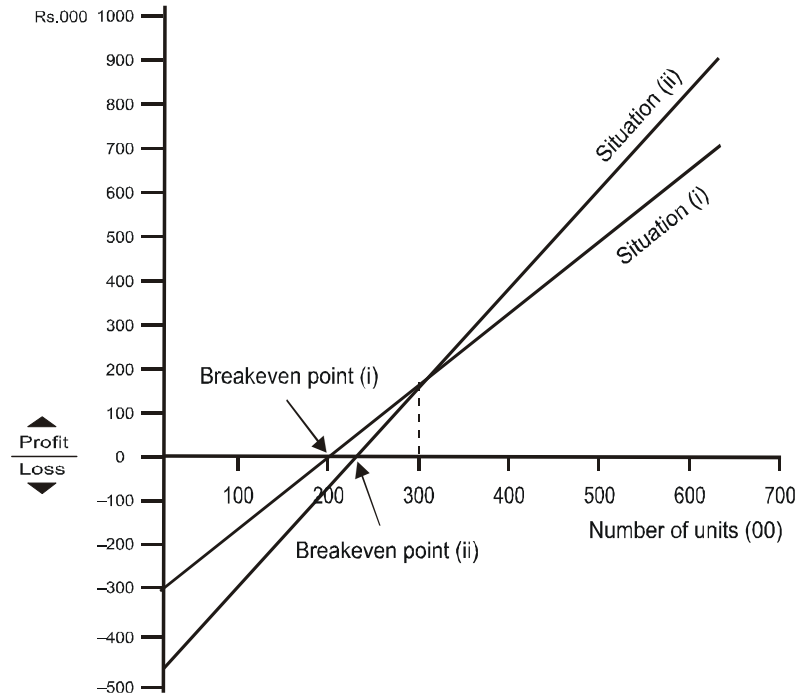
- (i) Draw a profit volume graph, and use it to determine the breakeven point.

The company is deliberating upon an increase in the selling price of the product to ₹350 per unit. This shall be required in order to improve the quality of the product. It is anticipated that despite increase in the selling price the sales volume shall remain unaffected, however, the fixed costs shall increase to ₹4,50,000 per annum and the variable costs to ₹330 per unit.

- (ii) Draw on the same graph as for part (a) a second profit volume graph and give your comments.

Solution:

Figure showing changes with a profit-volume chart



Working notes (i)

The profit for sales of 70,000 units is ₹ 7,50,000.

	(₹'000)
Contribution 70,000 × (₹300 – ₹285)	1050
Fixed costs	300
Profit	750

This point is joined to the loss at zero activity, ₹ 3,00,000 i.e., the fixed costs.

Working notes (ii)

The profit for sales of 70,000 units is ₹ 9,50,000.

	(₹'000)
Contribution 70,000 × (₹350 – ₹330)	1400
Fixed costs	450
Profit	950

This point is joined to the loss at zero activity, ₹ 4,50,000 i.e., the fixed costs.

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Comments:

It is clear from the graph that there are larger profits available from option (ii). It also shows an increase in the break-even point from 20,000 units to 22,500 units, however, the increase of 2,500 units may not be considered large in view of the projected sales volume. It is also possible to see that for sales volumes above 30,000 units the profit achieved will be higher with option (ii). For sales volumes below 30,000 units option (i) will yield higher profits (or lower losses).

Illustration 24 (Drawing of Break-even chart)

You are given the following data for the year 2007 of Rio Co. Ltd:

Variable cost	60,000	60%
Fixed cost	30,000	30%
Net profit	<u>10,000</u>	<u>10%</u>
Sales	<u>1,00,000</u>	100%

Find out (a) Break-even point, (b) P/V ratio, and (c) Margin of safety. Also draw a break-even chart showing contribution and profit.

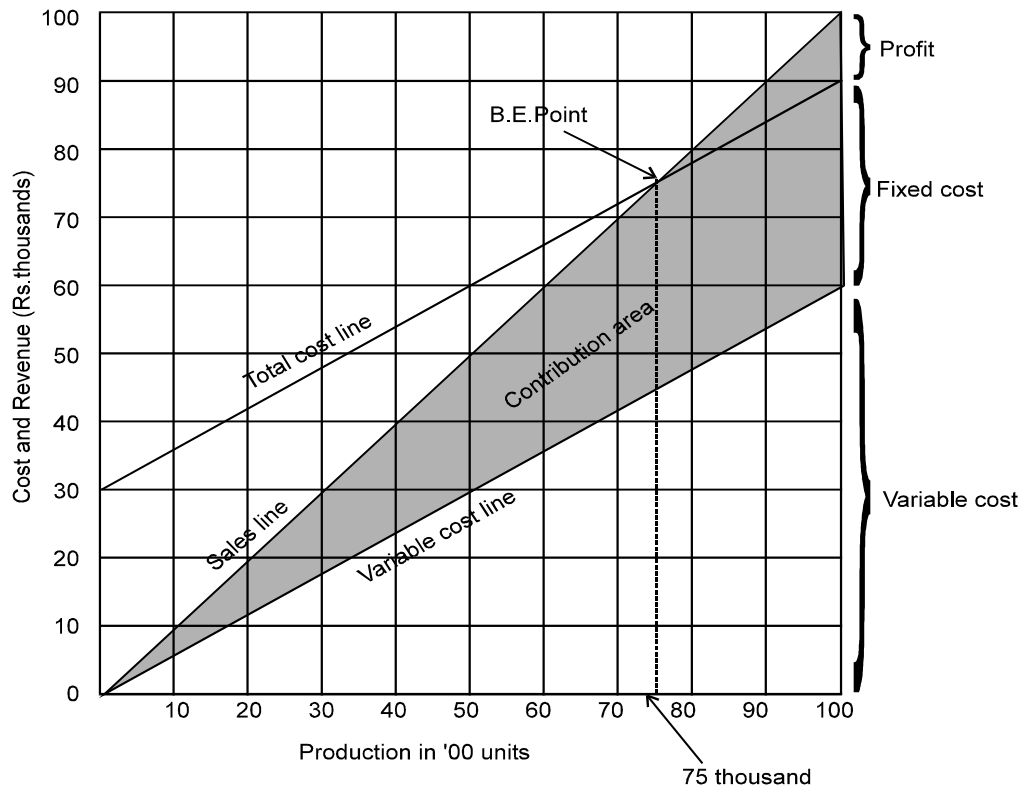
Solution:

$$\text{P/V ratio} = \frac{\text{Sales} - \text{Variable Cost}}{\text{Sales}} = \frac{1,00,000 - 60,000}{1,00,000} = 40\%$$

$$\text{Break Even Point} = \frac{\text{Fixed Cost}}{\text{P/V ratio}} = \frac{30,000}{40\%} = ₹ 75,000$$

$$\text{Margin of safety} = \text{Actual Sales} - \text{BE point} = 1,00,000 - 75,000 = ₹ 25,000$$

Break even chart showing contribution is shown below:



Break-even chart

Illustration 25 (Drawing of Break-even chart)

(a) You are given the following data for the coming year for a factory.

Budgeted output 8,00,000 units

Fixed expenses 40,00,000

Variable expenses per unit ₹ 100

Selling price per unit ₹ 200

Draw a break-even chart showing the break-even point.

(b) If price is reduced to ₹ 180, what will be the new break-even point?

Solution:

(a) Contribution = S – V = ₹ 200 – ₹ 100 = ₹ 100 per unit.

$$\text{B.E. Point} = \frac{\text{Fixed cost}}{\text{Contribution per unit}} = \frac{40,00,000}{₹ 100} = 40,000$$

(b) When selling price is reduced

New selling price = ₹ 180

12.43 Cost Accounting

New Contribution = ₹ 180 – ₹ 100 = ₹ 80 per unit.

New B.E. Point = $\frac{\text{₹ } 40,00,000}{\text{₹ } 80} = 50,000$ units.

The break-even chart is shown below:

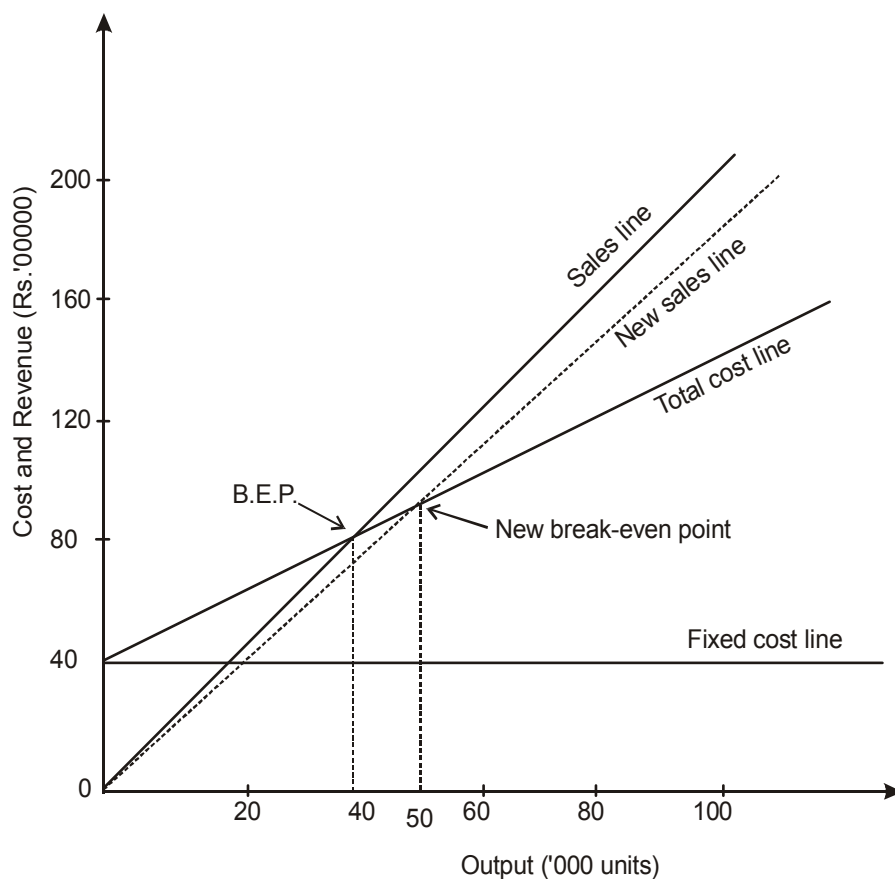


Illustration 26 (Drawing of Profit Graph)

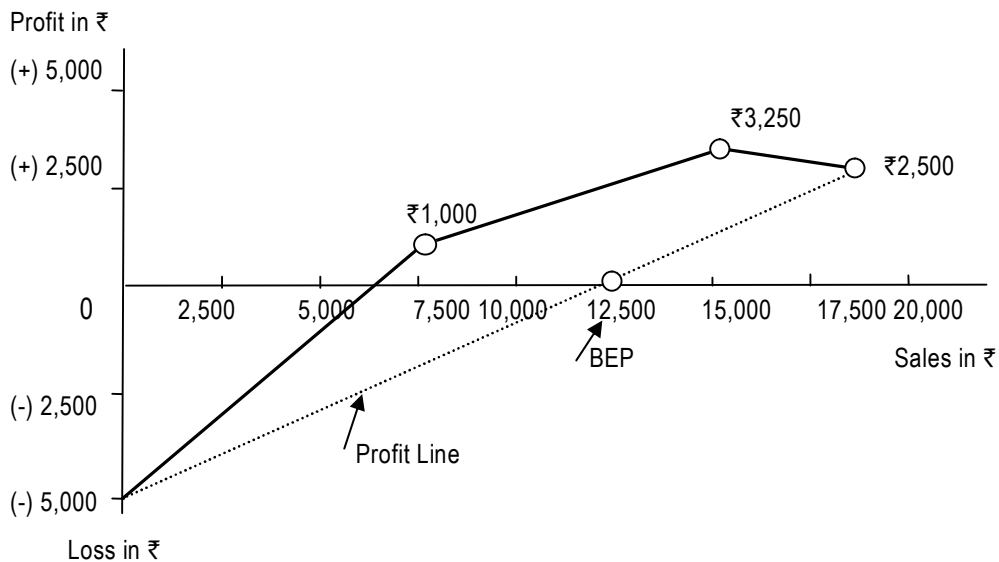
Prepare a profit graph for products A, B and C and find break-even point from the following data:

Products	A	B	C	Total
Sales (₹)	7,500	7,500	3,750	18,750
Variable cost (₹)	1,500	5,250	4,500	11,250
Fixed cost (₹)	---	---	---	5,000

Solution:

Statement Showing Cumulative Sales & Profit

Sales	Cumulative Sales		Variable Cost	Contribution	Cumulative Contribution	Cumulative Profit
	(₹)	(₹)	(₹)	(₹)	(₹)	(₹)
A	7,500	7,500	1,500	6,000	6,000	1,000
B	7,500	15,000	5,250	2,250	8,250	3,250
C	3,750	18,750	4,500	(750)	7,500	2,500



Break Even Point (BEP) = ₹ 12,500

12.13 The Limitations of Breakeven Analysis

The limitations of the practical applicability of breakeven analysis and breakeven charts stem mostly from the assumptions underlying CVP which have been mentioned above. Assumptions like costs behaving in a linear fashion or sales revenue remain constant at different sales levels or the stocks shall remain constant period after period are unrealistic. Similarly, the assumption that the only factor which influences costs is the 'activity level achieved' is erroneous because other factors like inflation also have a bearing on costs.

12.14 Summary

- **Absorption Costing:** a method of costing by which all direct cost and applicable overheads are charged to products or cost centers for finding out the total cost of production. Absorbed cost includes production cost as well as administrative and other cost.
- **Break-even Chart:** A mathematical or graphical representation, showing approximate profit or loss of an enterprise at different levels of activity within a limited range.
- **Break-even Point** the level of activity there is neither a profit nor a loss.

$$\text{Break-even Point in units} = \frac{\text{Fixed costs}}{\text{Contribution per unit}}$$

- **Cash Break Even Point** the level of activity where there is neither a cash profit nor a cash loss.
- **Cost Breakeven Point** the level of activity where the total cost under two alternatives are the same. It is also known as Cost indifference point.
- **Differential Costing** a technique used in the preparation of adhoc information in which only cost and income differences in between alternative courses of action are taken into consideration.
- **Direct Costing** a principle under which all costs which are directed related are charged to products, processes, operations or services, of which they form an integral part.
- **Marginal Contribution** difference between selling price and variable cost of production.
- **Marginal Cost** the variable cost of one unit of product or a service.
- **Marginal Cost Equation : $S \times U - V \times U = F \pm P$**
- **Marginal Costing** a principle whereby variable cost are charged to cost units and fixed cost attributable to the relevant period is written off in full against contribution for that period.
- **Profit Volume Chart** a diagram showing the expected relationship between costs, revenue at various volumes with profit being the residual.
- **Profit Volume Ratio** the ratio establishing the relationship between the contribution and the sales value.
- **Margin of Safety** is the difference between the expected level of sales and the break even sales
- **Projected Sales – Break even sales**